

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A vehicular window assembly suitable for use in a vehicle, said window assembly comprising:

a glass panel;

an attachment member; and

5 a layer of a rapid set, rapid cure, two-component urethane adhesive disposed between said glass panel and said attachment member, said layer of adhesive cured to form a joint suitable for use on a vehicle.

2. The vehicular window assembly of claim 1 wherein said adhesive comprises an isocyanate component and a polyol component, and said rapid set characteristic is such that after mixing said isocyanate component and said polyol component, and after relatively promptly contacting said glass panel to said attachment member, said glass panel and said attachment member are held by said adhesive against movement resulting from weight of said panel and said attachment member, and held by said adhesive against movement resulting from application of a relatively slight force, within a time period of about 3 minutes or less from the time of mixing and application of said adhesive to said panel and said attachment member.

3. The vehicular window assembly of claim 2 wherein said time period is about 90 seconds or less.

4. The vehicular window assembly of claim 3 wherein said time period is about 45 seconds or less.

5. The vehicular window assembly of claim 1 wherein said rapid cure characteristic is such that said adhesive cures in a time period of less than about 60 minutes.

6. The vehicular window assembly of claim 5 wherein said rapid cure characteristic is such that said adhesive cures in a time period of less than about 50 minutes.

7. The vehicular window assembly of claim 6 wherein said rapid cure characteristic is such that said adhesive cures in a time period of less than about 40 minutes.

8. The vehicular window assembly of claim 1 wherein said rapid cure characteristic is such that at least about 80% of the physical characteristics of the cured adhesive are obtained within about 60 minutes from the time of adhesive set.

9. The vehicular window assembly of claim 1 further comprising:
a layer of at least one of an adhesive promoter and a primer disposed between said glass panel and said layer of adhesive.

10. The vehicular window assembly of claim 9 wherein said at least one of said adhesion promoter and said primer is selected from the group consisting of silane compounds, titanium coupling agents, zirconium coupling agents, and moisture-curable urethane prepolymers.

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11. The vehicular window assembly of claim 10 wherein the thickness of said layer of at least one of said adhesion promoter and said primer is from about 0.01 mils to about 3.5 mils.
12. The vehicular window assembly of claim 11 wherein the thickness of said layer of at least one of said adhesion promoter and said primer is from about 0.05 mils to about 2 mils.
13. The vehicular window assembly of claim 12 wherein the thickness of said layer of at least one of said adhesion promoter and said primer is from about 0.1 mils to about 1.0 mils.
14. The vehicular window assembly of claim 1 further comprising:
a glass frit layer disposed on said glass panel.
15. The vehicular window assembly of claim 1 wherein the thickness of said adhesive disposed between said attachment member and said glass panel is from about 0.01 mm to about 4.0 mm.
16. The vehicular window assembly of claim 15 wherein the thickness of said adhesive is from about 0.25 mm to about 2.0 mm.
17. The vehicular window assembly of claim 16 wherein the thickness of said adhesive is from about 0.5 mm to about 1.0 mm.

18. A bonded vehicular assembly suitable for use in a vehicle, said assembly comprising:
a glass substrate;

an attachment member comprising a material selected from the group consisting of metal, plastic, and combinations thereof; and

5 a layer of a rapid set, rapid cure, two-component urethane adhesive disposed between and bonding said glass substrate and said attachment member, wherein upon curing of said adhesive, a joint suitable for use on a vehicle is formed.

19. The bonded vehicular assembly of claim 18 wherein said adhesive comprises:

an isocyanate component; and

a polyol component.

20. The bonded vehicular assembly of claim 19 wherein said polyol component includes a high amine density plural amine in an amount of from about 2% to about 20% by weight of said polyol component.

21. The bonded vehicular assembly of claim 19 wherein said adhesive further comprises:

at least one filler agent in at least one of said isocyanate component and said polyol component, wherein said filler agent is in an amount of from about 15% to about 50% of the total weight of said polyol and isocyanate components.

22. The bonded vehicular assembly of claim 21 wherein said filler agent is in an amount of from about 20% to about 30% of the total weight of said polyol and said isocyanate components.

23. The bonded vehicular assembly of claim 21 wherein said filler agent is selected from the group consisting of silicates, silica, calcium carbonate, talc, and combinations thereof.

24. The bonded vehicular assembly of claim 19 wherein said isocyanate component comprises compounds with isocyanate functionality and said polyol component comprises compounds with hydroxy and/or amino functionality, and wherein the ratio of isocyanate functionality to hydroxy and amino functionality is from about 0.9 to about 2.0.

25. The bonded vehicular assembly of claim 24 wherein said ratio of isocyanate functionality to hydroxy and amine functionality is from about 1.03 to about 1.4.

26. The bonded vehicular assembly of claim 25 wherein said ratio of isocyanate functionality to hydroxy and amino functionality is from about 1.1 to about 1.3.

27. The bonded vehicular assembly of claim 20 wherein said high amine density plural amine is a compound having an amine to carbon ratio of from about 1.0 to about 0.25:1, wherein (i) the compound contains at least 3 amine groups except if said compound is aromatic then said compound contains at least 2 amine groups, and (ii) the compound contains from 2 to 24 carbon atoms.

28. The bonded vehicular assembly of claim 27 wherein said high amine density plural amine has a molecular weight of from about 115 to about 5000.

29. The bonded vehicular assembly of claim 28 wherein said high amine density plural amine has a molecular weight of from about 210 to about 290.

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30. The bonded vehicular assembly of claim 27 wherein said high amine density plural amine comprises a reaction product of (i) at least one of pentaerythritol, glucose, and sucrose, and (ii) at least one member selected from the group consisting of ammonia and amino alkanes of the formula $C_xH_nNH_2$, wherein x ranges from 1 to 20 and n is such that the alkane is saturated.
31. The bonded vehicular assembly of claim 30 wherein x ranges from about 1 to about 6.
32. The bonded vehicular assembly of claim 31 wherein x ranges from about 1 to about 3.
33. The bonded vehicular assembly of claim 27 wherein said high amine density plural amine compound has from 11 to 12 carbon atoms.
34. The bonded vehicular assembly of claim 18 further comprising a layer of at least one of an adhesion promoter and a primer disposed between said glass substrate and said layer of adhesive.
35. The bonded vehicular assembly of claim 34 wherein said at least one of said adhesion promoter and said primer is selected from the group consisting of silane compounds, titanium coupling agents, zirconium coupling agents, and moisture-curable urethane prepolymers.
36. The bonded vehicular window assembly of claim 35 wherein said assembly is a movable vehicular window assembly.

37. The movable window assembly of claim 36 wherein said assembly further comprises:
a glass frit layer disposed on said glass substrate.
38. The movable window assembly of claim 36 wherein said assembly further comprises:
at least one hinge bonded to said glass substrate.
39. The movable window assembly of claim 38 wherein said hinge comprises a first
portion and a second portion that is movable with respect to said first portion, and wherein
said first portion is bonded to said glass substrate by an effective amount of said adhesive
disposed between and contacting said first portion and said glass substrate.
40. The movable window assembly of claim 39 wherein said second portion of said hinge
is affixed to a vehicular mounting surface.
41. A vehicular panel assembly suitable for use in a vehicle, said assembly comprising:
a glass substrate;
at least one attachment member affixed to said glass member; and
a layer of a two-component urethane adhesive disposed between and affixing said at
least one attachment member to said glass substrate, said layer of adhesive cured to form a
joint suitable for use on a vehicle, wherein said adhesive comprises an isocyanate component
and a polyol component.

47. A method of adhering an attachment member to a glass surface, said method comprising:

providing a substrate having a glass surface;

providing an attachment member to be adhered to said glass surface, said attachment member having a mounting surface;

providing a rapid set, rapid cure, two-component urethane adhesive;

depositing an effective amount of said adhesive on at least one of said attachment member mounting surface and said glass surface;

positioning said attachment member and said substrate such that said adhesive is disposed between and contacting said attachment member and at least a portion of said glass surface of said substrate; and

curing said adhesive.

48. The method of claim 47 wherein said adhesive comprises an isocyanate component and a polyol component including a high amine density plural amine compound, and wherein said method further comprises, prior to said depositing said adhesive, a step of:

mixing said isocyanate component and said polyol component.

49. The method of claim 48 wherein said high amine density plural amine compound is in an amount of from about 2% to about 20% by weight of said polyol component and said adhesive further comprises at least one filler agent in at least one of said isocyanate component and said polyol component, wherein said filler agent is in an amount of from about 15% to about 50% of the total weight of said polyol and isocyanate components.

50. The method of claim 49 wherein said filler agent is in an amount of from about 20% to about 30% of the total weight of said polyol and said isocyanate components.

51. The method of claim 49 wherein said filler agent is selected from the group consisting of silicates, silica, calcium carbonate, talc, and combinations thereof.

52. The method of claim 48 wherein said isocyanate component comprises compounds with isocyanate functionality and said polyol component comprises compounds with hydroxy and/or amino functionality, and wherein the ratio of isocyanate functionality to hydroxy and amino functionality is from about 0.9 to about 2.0.

53. The method of claim 52 wherein said ratio of isocyanate functionality to hydroxy and amine functionality is from about 1.03 to about 1.4.

54. The method of claim 53 wherein said ratio of isocyanate functionality to hydroxy and amino functionality is from about 1.1 to about 1.3.

55. The method of claim 48 wherein said high amine density plural amine compound is a compound having an amine to carbon ratio of from about 1.0 to about 0.25:1 with the provisos that (i) the compound contains at least 3 amine groups except if said compound is aromatic then said compound contains at least 2 amine groups, and (ii) the compound contains from 2 to 24 carbon atoms.

56. The method of claim 55 wherein said high amine density plural amine compound has a molecular weight of from about 115 to about 5000.

57. The method of claim 56 wherein said high amine density plural amine compound has a molecular weight of from about 210 to about 290.

58. The method of claim 48 wherein said high amine density plural amine comprises a reaction product of (i) at least one of pentaerythritol, glucose, and sucrose, and (ii) at least one member selected from the group consisting of ammonia and amino alkanes of the formula $C_xH_nNH_2$, where x ranges from 1 to 20 and n is such that the alkane is saturated.

59. The method of claim 58 wherein x ranges from about 1 to about 6.

60. The method of claim 47 further comprising, prior to depositing said adhesive, a step of:

depositing a layer of at least one of an adhesion promoter and a primer to at least one of said glass surface and said attachment member mounting surface.

61. The method of claim 47 wherein the thickness of said adhesive disposed between said attachment member and at least a portion of said glass surface is from about 0.01 mm to about 4.0 mm.

62. The method of claim 61 wherein the thickness of said adhesive is from about 0.25 mm to about 2.0 mm.

63. The method of claim 62 wherein the thickness of said adhesive is from about 0.5 mm to about 1.0 mm.

64. The method of claim 47 wherein said depositing step is performed by robotic deposition.

65. The method of claim 47 wherein said depositing step is performed by utilizing a dispense metering unit and a mixing unit.

66. The method of claim 65 wherein said mixing unit is a static mix tube in association with a sequential reverse static mixer.

67. The method of claim 65 wherein said providing a rapid set, rapid cure, two-component urethane adhesive is performed by delivering said adhesive through thermally controlled lines to said dispense metering unit.

68. The method of claim 47 wherein said curing step is accelerated by heating said adhesive.

69. The method of claim 68 wherein said heating is performed by a method selected from the group consisting of induction curing, infra red heating, and combinations thereof.

70. A method of adhering an attachment member to a glass substrate, said method comprising:

providing a glass substrate;

providing an attachment member to be adhered to said glass substrate, said attachment member having a mounting surface;

providing a rapid set, rapid cure, two-component urethane adhesive;

forming a frit layer on said glass substrate;

depositing an effective amount of said adhesive on at least one of said attachment member mounting surface and said frit layer;

positioning said attachment member and said substrate such that said adhesive is disposed between and contacting said attachment member and at least a portion of said frit layer formed on said substrate; and

curing said adhesive.

71. A moveable vehicular window assembly comprising:

a glass panel comprising a layer of frit disposed on at least one of its surfaces;

an attachment member comprising a material selected from the group consisting of metal, plastic, and combinations thereof; and

a layer of a rapid set, rapid cure, two-component urethane adhesive disposed between said layer of frit and said attachment member, wherein said adhesive comprises an isocyanate component and a polyol component, said layer of adhesive cured to form a joint suitable for use on a vehicle.

72. The movable vehicular window assembly of claim 71 wherein said rapid set characteristic is such that after mixing said isocyanate component and said polyol component, and after relatively promptly contacting said glass panel to said attachment member, said glass panel and said attachment member are held by said adhesive against movement resulting from weight of said panel and said attachment member, and held by said adhesive against movement resulting from application of a relatively slight force, within a time period of about 3 minutes or less from the time of mixing and application of said adhesive to said panel and said attachment member.

73. The movable vehicular window assembly of claim 72 wherein said time period is about 90 seconds or less.

74. The movable vehicular window assembly of claim 73 wherein said time period is about 45 seconds or less.

75. The movable vehicular window assembly of claim 71 wherein said rapid cure characteristic is such that said adhesive cures in a time period of less than about 60 minutes.

76. The movable vehicular window assembly of claim 75 wherein said rapid cure characteristic is such that said adhesive cures in a time period of less than about 50 minutes.

77. The movable vehicular window assembly of claim 76 wherein said rapid cure characteristic is such that said adhesive cures in a time period of less than about 40 minutes.

78. The moveable vehicular window assembly of claim 71 wherein said attachment member is selected from the group consisting of mounting components, hinges, clevises, latches, lift brackets, division bars, guide tracks, handles, guide pins, strut-mounting hardware, strikers, brake lights, power-mounting hardware, rails, gaskets, antennas, wiper mounts, cosmetic articles, and rearview mirrors.

79. The movable vehicular window assembly of claim 71 wherein said movable vehicular window assembly is adapted to be a window assembly selected from the group consisting of a hinged window assembly, a sunroof, a door lift window, a liftgate, and a sliding window assembly.

80. The movable vehicular window assembly of claim 71 further comprising:
a layer of at least one of an adhesive promoter and a primer disposed between said glass panel and said layer of adhesive.

81. The movable vehicular window assembly of claim 80 wherein said at least one of said adhesion promoter and said primer is selected from the group consisting of silane compounds, titanium coupling agents, zirconium coupling agents, and moisture-curable urethane prepolymers.

82. The movable vehicular window assembly of claim 81 wherein the thickness of said layer of at least one of said adhesion promoter and said primer is from about 0.01 mils to about 3.5 mils.

83. The movable vehicular window assembly of claim 82 wherein the thickness of said layer of at least one of said adhesion promoter and said primer is from about 0.05 mils to about 2 mils.

84. The movable vehicular window assembly of claim 83 wherein the thickness of said layer of at least one of said adhesion promoter and said primer is from about 0.1 mils to about 1.0 mils.

85. The movable vehicular window assembly of claim 71 wherein the thickness of said adhesive disposed between said attachment member and said glass panel is from about 0.01 mm to about 4.0 mm.

86. The movable vehicular window assembly of claim 85 wherein the thickness of said adhesive is from about 0.25 mm to about 2.0 mm.

87. The movable vehicular window assembly of claim 86 wherein the thickness of said adhesive is from about 0.5 mm to about 1.0 mm.

5 88. A window assembly suitable for use in a vehicle, said assembly comprising:
a glass panel;
an attachment member adapted for attachment to said glass panel; and
a layer of a rapid set, rapid cure, two-component urethane adhesive disposed between said glass panel and said attachment member, wherein said adhesive comprises an isocyanate component and a polyol component, and wherein said adhesive is capable, upon curing, to form a bond that can withstand a tensile force of at least 5 lbs/in².

89. A hinged vehicular window assembly for a vehicle suitable for use in a vehicle, said assembly comprising:

a glass panel having a layer of glass frit disposed on at least a portion of one of its surfaces;

5 a hinged mounting member having a first portion bonded to said glass panel by an effective amount of a rapid set, rapid cure, two-component urethane adhesive disposed between said glass panel and said first portion, said adhesive cured to form a joint suitable for use on a vehicle, said hinged mounting member further having a second portion adapted for affixment to a mounting surface.

96. The hinged assembly of claim 95 wherein said filler agent is in an amount of from about 20% to about 30% of the total weight of said polyol and said isocyanate components.

97. The hinged assembly of claim 96 wherein said filler agent is in an amount of about 25% of the total weight of said polyol and said isocyanate components.

98. The hinged assembly of claim 95 wherein said filler agent is selected from the group consisting of silicates, silica, calcium carbonate, talc, and combinations thereof.

99. The hinged assembly of claim 89 further comprising:

a layer of at least one of an adhesion promoter and a primer disposed between said glass panel and said adhesive.

100. The hinged assembly of claim 99 wherein said adhesion promoter and said primer are selected from the group consisting of silane compounds, titanium coupling agents, zirconium coupling agents, and moisture-curable urethane prepolymers.

101. The hinged assembly of claim 100 wherein said layer of at least one of said adhesion promoter and said primer has a thickness of from about 0.01 mils to about 3.5 mils.

102. The hinged assembly of claim 101 wherein said thickness of said layer of at least one of said adhesion promoter and said primer is from about 0.05 mils to about 2 mils.

103. The hinged assembly of claim 102 wherein said thickness of said layer of at least one of said adhesion promoter and said primer is from about 0.1 mils to about 1.0 mils.

104. The hinged assembly of claim 89 wherein said hinged mounting member is formed from a material selected from the group consisting of metal, plastic, and combinations thereof.

105. The hinged assembly of claim 104 wherein said hinged mounting member bonded to said glass panel is able to withstand a tensile force of at least 500 psi exerted perpendicular to said plane of said glass panel without failure of said adhesive.

106. The hinged assembly of claim 89 wherein said adhesive has a thickness of from about 0.01 mm to about 4.0 mm.

107. The hinged assembly of claim 106 wherein said adhesive has a thickness of from about 0.25 mm to about 2.0 mm.

108. The hinged assembly of claim 107 wherein said adhesive has a thickness of from about 0.5 mm to about 1.0 mm.

109. The hinged assembly of claim 89 wherein said second portion of said hinged mounting member is affixed to a mounting surface of a vehicle selected from the group consisting of automobiles, trucks, vans, minivans, utility vehicles, motor homes, campers, trailers, buses, trolleys, trains, commuter vehicles, airplanes and boats.

110. A movable window assembly for a vehicle suitable for use in a vehicle, said assembly comprising:

a glass panel; and

an attachment member bonded to said glass panel by an effective amount of an adhesive disposed between said mounting member and said glass panel, said adhesive comprising an isocyanate component and a polyol component.

111. The movable window assembly of claim 110 wherein said attachment member is selected from the group consisting of mounting components, hinges, clevises, latches, lift brackets, division bars, guide tracks, handles, guide pins, strut-mounting hardware, strikers, brake lights, power-mounting hardware, rails, gaskets, antennas, wiper mounts, cosmetic articles and rearview mirrors.

112. The movable window assembly of claim 110 wherein said assembly is selected from the group consisting of hinged window assemblies, sunroofs, door lift windows, liftgates, and sliding window assemblies.

113. The movable window assembly of claim 110 wherein said adhesive disposed between and bonding said attachment member to said glass panel forms a layer having a thickness of from about 0.01 mm to about 4.0 mm.

114. The movable window assembly of claim 113 wherein said layer of adhesive has a thickness of from about 0.25 mm to about 2.0 mm.

115. The movable window assembly of claim 114 wherein said layer of adhesive has a thickness of from about 0.5 mm to about 1.0 mm.

116. The movable window assembly of claim 110 further comprising:

a layer of at least one of an adhesion promoter and a primer disposed between said glass panel and said adhesive.

117. The movable window assembly of claim 116 wherein said adhesion promoter and said primer are selected from the group consisting of silane compounds, titanium coupling agents, zirconium coupling agents, and moisture-curable urethane prepolymers.

118. The movable window assembly of claim 117 wherein said layer of at least one of said adhesion promoter and said primer has a thickness of from about 0.01 mils to about 3.5 mils.

119. The movable window assembly of claim 118 wherein said thickness of said layer of at least one of said adhesion promoter and said primer is from about 0.05 mils to about 2 mils.

120. The movable window assembly of claim 119 wherein said thickness of said layer of at least one of said adhesion promoter and said primer is from about 0.1 mils to about 1.0 mils.

121. The movable window assembly of claim 110 wherein said glass panel is selected from the group consisting of opaque or coated glass, privacy glass, glass having a layer of frit, tinted glass, solar tinted glass, multi-composite glass laminates, and combinations thereof.

122 The movable window assembly of claim 110 wherein said assembly further comprises:

a frit layer disposed on said glass panel.

123. A positionable sunroof adapted and suitable for use in a vehicle, said sunroof comprising:

a glass panel;

at least one hinge component having a first portion affixed to said glass panel and a
5 second portion being adapted for attachment to a vehicle mounting surface; and

a layer of a rapid set, rapid cure, two-component urethane adhesive disposed between
a portion of said glass panel and said first portion of said hinge component, wherein said
adhesive is cured thereby affixing said first portion of said hinge component to said glass
panel.

124. A movable door lift window assembly adapted and suitable for use in a vehicle, said
door lift window assembly comprising:

a glass panel;

at least one lift bracket bonded to said glass panel by an effective amount of a rapid
5 set, rapid cure, two-component urethane adhesive disposed between said glass panel and said
at least one lift bracket.

125. A liftgate window assembly adapted and suitable for use in a vehicle, said liftgate comprising:

a glass panel; and

at least one hinge having a first member affixed to said glass panel by a layer of a rapid set, rapid cure, two-component adhesive disposed between a portion of said glass panel and said first member, said hinge further having a second member positionably movable with respect to said first member and adapted for attachment to a vehicle.

126. A sliding window assembly adapted and suitable for use in a vehicle, said assembly comprising:

a first glass panel;

at least one guide track bonded to an edge of said first glass panel by an effective amount of a rapid set, rapid cure, two-component urethane adhesive, said guide track having a channel configured to slidably receive a glass panel; and

a second glass panel slidably disposed in said channel of said guide track.

127. The sliding window assembly of claim 126 wherein said first glass panel has a pin component bonded to it by an effective amount of said adhesive, and said second glass panel has a latch component bonded to it by an effective amount of said adhesive, wherein said latch component is adapted to releasably engage said pin component.

128. The sliding window assembly of claim 126 further comprising a third glass panel.

129. The sliding window assembly of claim 128 wherein said at least one guide track is bonded to an edge of said third glass panel by an effective amount of said adhesive.

